

THE OCCURRENCE AND HYBRID NATURE OF AN
ENCHANTER'S NIGHTSHADE IN OHIO

TOM S. COOPERRIDER

Floristic work by the writer¹ and one of his students in northeastern Ohio during the summer of 1960 yielded two collections of *Circaea canadensis* Hill, making it possible to add this species with certainty to the known state flora. Schaffner (1932) noted that this species had been reported for the state but that he had seen no specimens. The state is not cited as part of the species range in either of the two regional manuals (Fernald, 1950; Gleason, 1952), but its known occurrences in neighboring states of Pennsylvania, West Virginia, and Michigan make its presence here not unexpected. Examination of the *Circaea* specimens in the Herbarium of The Ohio State University² disclosed one earlier collection: *Ash Cave, Hocking County, E. A. Albaugh & Len. Stephenson, Summer, 1930*. This is a fragmentary specimen originally identified as *C. lutetiana* L., but is undoubtedly *C. canadensis*. This station, located in southeastern Ohio, has not yet been visited by the writer.

The two newly discovered stations are in the extreme northeastern part of the state. The original collections from both have been added to the Herbarium of Kent State University. The collection data are:

(1) Open wooded slope; east side of Brewster Road and north of Chagrin River where the two cross; Bainbridge Township, Geauga County. *W. D. Hawver 1123*, July 25, 1960. (2) Moist, rocky, wooded valley of Mill Creek at "Cassey's Springs" area, 2 miles NNW of Mesopotamia, Mesopotamia Twp., Trumbull County. *Tom S. Cooperrider 7924*, Aug. 11, 1960.

The nature of *C. canadensis* has been the subject of past conjecture, Gleason (*op. cit.*) noting that it is often considered a hybrid between the other two species *Circaea* in this area: *C. alpina* L. and *C. quadrisulcata* (Maxim.) Franch.

¹This field work was supported by a Kent State University Summer Faculty Research Appointment.

²Appreciation is expressed to Dr. Clara Weishaupt, curator of the herbarium, for the loan of these specimens.

& Sav. Fernald (1917), however, decided that the "range of the three species does not coincide and there is little to suggest hybrid characters". Field examination of the two newly discovered Ohio stations for *C. canadensis*, and measurements in the herbarium on a sample of ten or more specimens of this taxon from each location suggest that a re-evaluation of Fernald's arguments is appropriate.

Both stations in northeastern Ohio were studied in the summer of 1961. They are remarkably similar. Each is centered in a deep ravine of the type known locally as a "hemlock gorge". In each ravine, all three taxa of *Circaea* are growing. At the head of both ravines, a small stream falls over a sandstone cliff about 20 feet in height. *C. alpina* grows on or near the cliff in a moist, north-facing situation, usually on dripping, mossy ledges. Colonies of *C. canadensis* are in the rocky, wooded valley a few hundred feet downstream from the cliffs. In both valleys, some plants of *C. quadrisulcata* grow within a few feet of the *C. canadensis* plants. *C. quadrisulcata* is more abundant, however, in the dry, upland woods bordering the ravines. The proximity of the three taxa at these two stations would negate any argument against hybridization based on spatial separation.

That *C. canadensis* is generally intermediate in morphology between the other two species is apparent from casual observation (Plate 1267, Fig. 1) More specifically, its intermediacy with regard to:

stature,	length of corolla lobe,
length of leaf,	length of anther,
length of leading raceme,	length of fruit pedicel, and
width of calyx lobe,	thickness of fruit

has been noted previously (Fernald, 1950; Gleason, 1952). cursory measurements on Ohio specimens indicate that it is also intermediate, both in range of variation and in mean, with respect to:

number of internodes above roots,	length of disk above hypanthium,
position of longest internode,	length of calyx lobe,
length of longest internode,	width of corolla lobe,
width of leaf blade,	length of filament, and
length of flower bud,	size of pollen grain.

Stebbins (1950, p. 26) has reasoned on a genetic basis that "the larger the number of characters in which a particular plant can be found to be intermediate between its putative parents, the greater is the probability of its hybrid origin". The large number of morphologically intermediate charac-

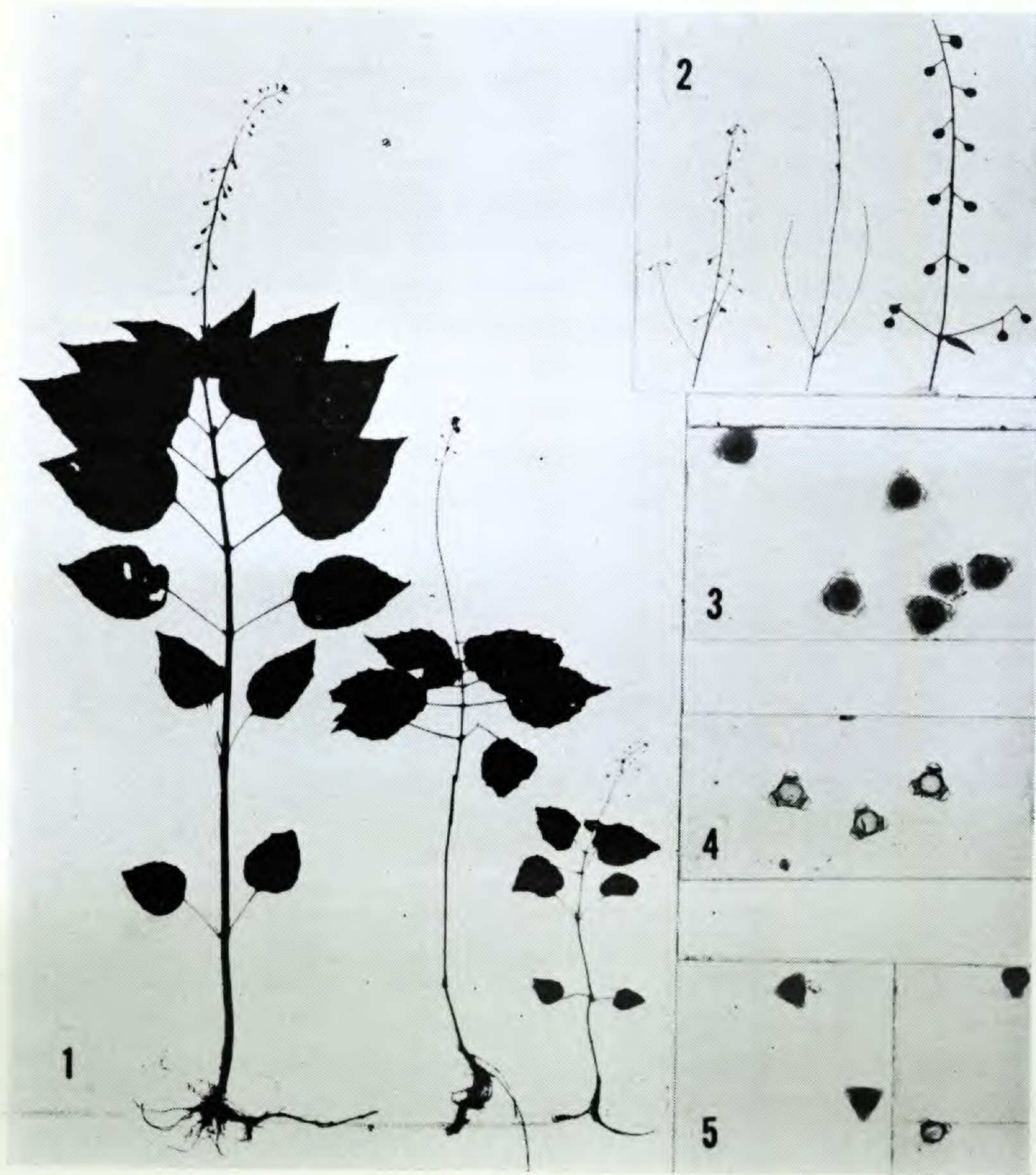


PLATE 1267

FIG. 1. Habit of representative plants. Left, *Circaea quadrisulcata*; center, *C. canadensis*; right, *C. alpina* (all $\times 1/6$). FIG. 2. Fruiting racemes collected from Geauga Co., Sept. 9, 1961. Left, *C. alpina*; center, *C. canadensis*; right, *C. quadrisulcata* (all $\times 1/4$). FIG. 3. *C. quadrisulcata*, six pollen grains that stained with aniline blue ($\times 100$). FIG. 4. *C. canadensis*, three pollen grains that did not stain with aniline blue ($\times 100$). FIG. 5. *C. alpina*, three pollen grains that stained with aniline blue, one that did not ($\times 100$).

ters in this case supports the notion of hybrid origin of *C. canadensis*.

Failure of fruit to set on *C. canadensis* is relevant. This feature is noted by Gleason (*op. cit.*), but not by Fernald (1917, 1950). Careful searching of the plants of *C. canadensis* in northeastern Ohio disclosed none with even a single fruit set in early September, 1961. Nearby plants of the other two species had set fruit abundantly (Fig. 2). Plants of all three taxa moved into garden culture in Spring of 1961 showed a similar pattern, both *C. alpina* and *C. quadrisulcata* set fruit abundantly; plants of *C. canadensis*, observed until killed by frost, set no fruit.

Fresh pollen of plants from each of the two stations in northeastern Ohio was stained with aniline blue in lactophenol (Fig. 3-5), a technique described by Lawrence (1951, p. 71) and Long (1959) as a test for fertility and, hence, possible hybridity. Pollen taken from two to six plants of each taxon from these two stations gave the following results:

1. For *C. alpina*, of 747 grains counted, 592 (79%) stained dark blue and 155 (21%) took no blue stain.
2. For *C. quadrisulcata*, of 1000 grains counted, 791 (79%) stained dark blue and 209 (21%) took no blue stain.
3. For *C. canadensis*, of 2036 grains counted, 11 (0.5%) stained dark blue, 173 (8.5%) showed a dark blue spot on the body of the grain, and 1852 (91%) took no blue stain.

Assuming only those grains which stained completely to be "good", this count reveals that while the amount of good pollen produced by *C. alpina* and *C. quadrisulcata* is 79%, that of nearby plants of *C. canadensis* is less than 1%. A second generalization by Stebbins (1950, p. 27) on the nature of interspecific hybrids is pertinent. "If the plant is completely healthy and growing in company with its putative parents, then the discovery of a high-proportion of well-filled pollen grains in the latter and 50% or more of empty ones in the suspected plant is strong evidence that this plant is a hybrid between the two forms that are partly isolated from each other genetically."

On the basis of spatial proximity, morphological intermediacy, and sterility, as indicated by failure of fruit to set and production of only a small percentage of good pollen, it seems reasonable to conclude that these plants of *C. canadensis* in northeastern Ohio are indeed interspecific hybrids of *C. alpina* x *C. quadrisulcata*.

In connection with the planning of further study of the matter, it is noteworthy that a similar, or perhaps the same, situation exists in Europe in *C. intermedia* Ehrh., which Fernald (1917) considered conspecific with *C. canadensis*. *C. intermedia* has been variously considered as a *Form* of *C. alpina*, a *Form* of *C. lutetiana*, an interspecific hybrid between the two, and as a distinct species (Hegi, 1908; Gagnepain, 1916). — DEPARTMENT OF BIOLOGICAL SCIENCES, KENT STATE UNIVERSITY, KENT, OHIO.

LITERATURE CITED

- FERNALD, M. L. 1917. The identity of *Circaea canadensis* and *C. intermedia*. *Rhodora* 19:85-88.
- . 1950. *Gray's Manual of Botany*. 8th ed. American Book Co., New York.
- GAGNEPAIN, F. 1916. Revision du genre *Circaea*. *Bull. Soc. Bot. France* 63:39-43.
- GLEASON, H. A. 1952. *New Britton and Brown Illustrated Flora of Northeastern United States and Adjacent Canada*. Lancaster Press, Lancaster, Pa. vol. 2.
- HEGI, G. 1908. *Illustrierte Flora von Mittel-Europa*. vol. 5, part II.
- LAWRENCE, G. H. M. 1951. *Taxonomy of Vascular Plants*. Macmillan Co., New York.
- LONG, R. W. 1959. Natural and artificial hybrids of *Helianthus Maximiliani* X *H. grosseserratus*. *Amer. Jour. Bot.* 46:687-692.
- SCHAFFNER, J. H. 1932. Revised catalog of Ohio vascular plants. *Ohio Biol. Survey, Bull.* 25. Ohio State University, Columbus.
- STEBBINS, G. L., JR. 1950. *Variation and evolution in plants*. Columbia Univ. Press, New York.